Hydration Technologies, Inc. – HydroPack

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Device Information

The Hydration Technologies, Inc., HydroPack is a portable passive water treatment device utilizing an osmotic membrane for pathogen reduction. The device consists of a 2 L vinyl bag with a semi-permeable membrane on one side. According to the manufacturer, the membrane, although unlike conventional porous membranes, is equivalent to having a pore size of 0.0005 µm. This device uses no pumping to process the water, but rather uses osmotic potential across the membrane as a driving force. The bag is placed directly into the raw water source and a nutrient charge of sugar and electrolytes in the bag pulls water across the membrane by creating an osmotic potential. To reduce this potential and equilibrate the solute concentration across the membrane, water is drawn from the less concentrated to the more concentrated side of the membrane until equilibrium is reached. The finished product is a sports drink similar to Gatorade®. Water production rate is proportional to solute gradient. The following nutrition information was approximated based on the X Pack, the reusable version of the HydroPack (Table 1). This information is based per charge (single use), recommended for the production of 2 L of product at 3.6% solution.

Table 1. HydroPack Nutrient Charge Nutritional Information.

Parameter	Value/2L Product
Calories	293
Total Fat	0 g
Sodium	40 g
Potassium	166 g
Sugars	73 g
Protein	0 g

Ingredients: fructose, water, citric acid, lime extract, sweetness enhancer, potassium citrate, sodium citrate, sodium benzoate, potassium sorbate.
Note: According to the manufacturer, the nutrient charge is undergoing reformulation.

® Gatorade is a registered trademark of the Quaker Oats Co., Chicago, IL. Use of trademarked products does not imply endorsement by the U.S. Army, but is intended only in identification of a specific product.

Effectiveness Against Microbial Pathogens

Manufacturer in-house data showed virus reduction in excess of 4-log (reference 1). Results from an independent laboratory for a similar device (HTI, Inc., X Pack) show bacteria reduction in excess of 6-log (reference 2). No results were received that tested this device against the U.S. Environmental Protection Agency (USEPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3). Expert opinion states that this technology should be capable of meeting the log reduction requirements shown below when tested against the USEPA Standard for the manufacturer rated capacity of the device. The removal mechanism of osmotic membranes is complex, but can be considered to be based on size exclusion utilizing very small pores that reject even dissolved contaminants. Based on the absence of independent results challenged against reference 3, this device is assigned a rating of one √ for the reduction of each pathogen (click here for rating explanation), indicating that expert opinion expects this device to meet the requirements of reference 3 (Table 2).

Table 2. Expected Performance Against Microbial Pathogens.

Microbial Pathogen Type	Expected Disinfection Capability	Evaluation Rating	Primary Pathogen Reduction Mechanism
Bacteria	> 6-log	√	size exclusion
Viruses	> 4-log	√	size exclusion
Giardia cysts	> 3-log	√	size exclusion
Cryptosporidium oocysts	> 3-log	√	size exclusion

Production Rate and Capacity

Production rate and capacity of this device is dependant upon solute gradient across the membrane and temperature. Manufacturer stated production rate is 1 L/6 hrs at 68º F. This device is designed for one use and is capable of producing 2 L of drink. Unlike porous pressure driven filter devices, turbidity does not affect the production capacity or rate.

Cleaning, Replacement, and End of Life Indicator

The HydroPack is a single use, disposable device not designed to be cleaned or reused.

Weight and Size

The dry weight of the device is about 300 grams.
Dimensions are (H x W x L) 4 cm x 10 cm x 18 cm.

Cost

HydroPack device	$18.00

Device Evaluation

No laboratory data was received or the Hydration Technologies, Inc., HydroPack challenging the device against the standards in reference 3. Since the device utilizes the same membrane as the Hydration Technologies, Inc., X Pack, the results showing > 6-log reduction of bacteria for that device apply to the HydroPack. Based on the characteristics of osmotic membranes, reduction of viruses (> 4-log) and cysts (> 3-log) to the standards of reference 3 should be obtainable (reference 4). This device entails a single step with no chemicals required or residuals added. The device is placed into the raw water source and must remain in the source for the duration of production. When placing the device into the raw source care should be taken to maintain the drink port above the water surface to prevent possible contamination. The driving force for water purification consists of a gradient in sugar and electrolyte concentration. To create this gradient a powder or liquid nutrient charge is inside the device. Because if this, the liquid produced is not water, but a drink similar to commercial sports drinks. The concentration of the drink with respect to sugar content can be adjusted by the user by consuming the drink prior to production completion or by pouring out some of the charge prior to use. Since drink production is related to solute gradient, producing a drink that is more dilute will require increased production time. Therefore, the already extremely slow production rate of 1 L every 6 - 8 hours increases. Conversely, creating a more concentrated drink will take less time, but will lower the overall amount of drink produced per device. Two other conditions that affect drink production, but to a lesser extent, are water temperature (increase in temperature will increase production rate) and the movement of the bag (slight movement or shaking periodically will increase production rate). The device is designed for single use with a capacity of 2 L. Care must be taken during storage and transport not to puncture or excessively abuse the bag by folding or creasing. Prior to consumption, the liquid in the bag should be observed to confirm that it is not similar in characteristics (color, cloudiness) to the raw water source. If the liquid in the bag resembles that of the raw source then the membrane may be defective and device and liquid should be discarded without consumption. This device has no real-time indicator of process failure. Small defects in the membrane may allow pathogens to enter the product bag and be consumed without notice. The manufacturer states a storage life of 3 years when kept below 90º F.

Advantages

- Technology is capable of reducing microbial pathogens in accordance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3).
- Osmotic membrane capable of rejecting microbial pathogens and most all other environmental contaminants.
- No chemicals required.
- Unaffected by raw water turbidity.

Disadvantages

- No test results showing compliance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3).
- Extremely slow production rate.
- Single use, able to process only 2 L of product.
- Device must remain in raw water source for duration of product drink production.
- No real-time indicator of process failure.
- Does not produce water; product is similar to a sports drink.

References

1. Manufacturer in-house laboratory test results showing > 4-log reduction of virus, 2003. Provided by HTI.

2. Independent laboratory results of tests showing >6 log reduction of bacteria, 2001. Provided by HTI.

3. USEPA, 1989. Guide Standard and Protocol for Testing Microbiological Water Purifiers. *Federal Register*. 54:34067.

4. U.S. Army Center for Health Promotion and Preventive Medicine, 2005. *Technical Information Paper; Filtration in the Use of Individual Water Purification Devices,* Aberdeen Proving Ground, MD.